HOUSED BUSH ROLLER ASSEMBLY

CROSS REFERENCE TO RELATED APPLICATIONS

The present application claims priority under 35 U.S.C. § 119(e) from U.S. Provisional Patent Application Serial No. 60/480,972, filed June 24, 2003, entitled "Housed Bush Roller", the disclosure of which is incorporated herein by reference.

FIELD OF THE INVENTION

This invention relates to rollers for load-bearing roller applications such as a sliding automotive door.

BACKGROUND OF THE INVENTION

Currently, roller bearings are used in a variety of applications where the bearing must support a load. One example of such an application is in automotive sliding doors, for example in a minivan. One current roller assembly 10, illustrated in FIG. 1, comprises an arm 12 fixed to the sliding door. The free end of the arm is attached to a sliding chariot 16 by a spring hinge 14 to allow for movement of the chariot 16 relative to the arm 12. The chariot 16 comprises two guide rollers 18 with a support roller 20 therebetween. The support roller 20 comprises an over-molded ball bearing attached to the arm by a pin 22. The support roller 20 carries the weight of the door while the guide rollers run through a tubular channel to guide the door during its movement.

The over-molded ball bearing currently employed in automotive applications is expensive relative to the total cost of the assembly and is susceptible to corrosion. Once the ball bearing begins to corrode, it can no longer adequately support the weight of the door. As the corrosion progresses, the ball bearing will wear dramatically and eventually fail. The weight of the door will then rest on the guide rollers which are not designed to carry such a load. Furthermore, the rolling low-friction contact between the door and the frame will be lost. This will eventually lead to damage to the door and/or doorframe.

Prior roller assemblies have not combined advantages of enhanced corrosion resistance with a low cost design that overcome disadvantages of a roller with multiple moving parts, such as a ball bearing, which are susceptible to corrosion and required to support the weight of the sliding door.

Thus, there is a need to provide a strong corrosion resistant roller assembly capable of supporting the weight of a door while sliding along its track with a minimum amount of resistance.

Additionally, there is a need to replace existing components that have already begun to corrode and fail. Furthermore, a solution that does not require extensive retooling of existing sliding door designs would be preferred in most applications.

It is, therefore, desirable to have a low-cost, non-corrosive bearing for use in load-bearing operations. It is to these perceived needs that the present invention is directed.

SUMMARY OF THE INVENTION

In a first aspect of the present invention, a roller assembly for guiding and supporting a moveable object within a track is provided comprising, a sliding chariot adapted to be affixed to a moveable object, and a supporting roller assembly comprising a supporting roller having an aperture through the center thereof, a pin secured at one end to said chariot and extending through the supporting roller aperture, and a bush positioned between said supporting roller and said pin to provide a sliding surface between said supporting roller and said pin. Further, the bush is mounted along the radially inner circumference of the supporting roller.

In one embodiment of the present invention, the aperture in the supporting roller comprises a middle section defined by a minimum diameter of the supporting roller and two end portions defined by diameters larger than the minimum diameter of the supporting roller. In another embodiment of the present invention, at least one end of the bush comprises a flanged section defined by an area of increased outer diameter. However, in a preferred embodiment of the present invention, both ends of the bush comprise flanged sections defined by areas of increased outer diameter.

In another embodiment of the present invention, the bush conforms to the shape of the supporting roller aperture including a middle portion having a minimum outside diameter and two end portions each having an outside diameter greater than said minimum diameter of the middle portion. The bush preferably comprises a metal-polymer bearing material, and more preferably comprises a polytetrafluoroethylene based metal/polymer bearing material.

In a further embodiment of the present invention, the roller assembly further comprises guide means for stabilizing said chariot in a non-vertical direction. In another

embodiment of the present invention, the roller assembly further comprises guide means for stabilizing said chariot in a horizontal direction. In a preferred embodiment of the present invention, the guide means comprises at least one guide roller rotatably affixed to said chariot to provide a rotating contact between the roller assembly and the guide track.

In an embodiment of the present invention, the pin further comprises an area of enlarged diameter on the inboard end, which provides lateral support to the roller by abutting the flanged portion of the bush. A riveted washer is affixed to one end of the pin to secure the supporting roller in position on the pin.

In another aspect of the present invention, a roller assembly for guiding and supporting a sliding door mounted to a guide track is provided comprising, a sliding chariot adapted to be affixed to a sliding door, a guide roller rotatably mounted to said chariot to rotate when in contact with a horizontal guide surface, and a supporting roller assembly comprising a supporting roller having an aperture through the center thereof, a pin secured at one end of said chariot and extending through the supporting roller aperture, and a bush positioned between said supporting roller and said pin to provide a sliding surface between said roller and said pin.

In one embodiment of the present invention, the aperture in the supporting roller comprises a middle section defined by a minimum diameter of the supporting roller and two end portions defined by diameters larger than the minimum diameter of the supporting roller. In another embodiment of the present invention, the bush conforms to the shape of the supporting roller aperture including a middle portion having a minimum outside diameter and two end portions each having an outside diameter greater than said minimum diameter of the middle portion.

Features of a roller assembly of the present invention may be accomplished singularly, or in combination, in one or more of the embodiments of the present invention. As will be appreciated by those of ordinary skill in the art, the present invention has wide utility in a number of applications as illustrated by the variety of features and advantages discussed below.

A roller assembly of the present invention provides numerous advantages over prior support roller assemblies. For example, the present invention advantageously provides a corrosion resistance roller mechanism with increased strength and load capacity.

Another advantage is that the present invention provides a roller assembly which is simpler in design than prior art roller assemblies and less expensive to manufacture. Furthermore, the support roller assembly of the present invention can be incorporated into existing designs without the need for substantial retooling or redesign.

As will be realized by those of skill in the art, many different embodiments of a roller assembly according to the present invention are possible. Additional uses, objects, advantages, and novel features of the invention are set forth in the detailed description that follows and will become more apparent to those skilled in the art upon examination of the following or by practice of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The features and advantages of the present invention will be disclosed in the following description with reference to the accompanying drawings illustrating the preferred embodiments, wherein:

FIG. 1 is a perspective view of a roller assembly and connective hinged arm as an example of the prior art designs exhibiting the problems overcome by the present invention.

FIG. 2 is a perspective view of a roller assembly and connective hinged arm in an embodiment of the present invention.

FIG. 3 is a perspective view of a support roller assembly in an embodiment of the present invention.

FIG. 4 is a schematic view of a supporting roller for use in a roller assembly in an embodiment of the present invention.

DETAILED DESCRIPTION

The present invention is described herein with reference to the preferred embodiments including reference to a preferred use in automotive sliding door applications. However, other load-bearing applications are well within the scope of the present invention and its use is not to be limited to any one particular application. The present invention has utility, for example, with lifting equipment, handling equipment, or other load bearing applications that traditionally use ball bearing rollers, and would benefit from the advantages of the present invention.

In a first aspect of the present invention, a roller assembly is provided comprising a sliding chariot adapted to be affixed to a movable object and a supporting roller assembly affixed to the chariot. A preferred embodiment of the supporting roller assembly is illustrated in FIG. 4. The supporting roller assembly comprises a roller 120, a bushing 130, and a pin 122.

In one embodiment of the present invention, the roller 120 is constructed of a rigid plastic or metallic material that has been formed into the desired shape. In a preferred embodiment of the present invention, the roller is cylindrical in nature defined by an outer circumference and an inner circumference defining an axial aperture running through the length of the supporting roller cylinder. The exterior of the roller 120 comprises an area of enlarged diameter which functions as the primary contact surface of the supporting roller, which rides along or in the guide track. The interior of the roller is dimensioned to accept the pin about which it will rotate during operation.

In another preferred embodiment of the present invention, the axial aperture of the roller comprises three sections: a middle section wherein the aperture has a minimum diameter, and two end sections wherein the aperture has a larger diameter. The middle section comprises the contact area between the pin and the roller. Preferably, this section is the longest of the sections to provide a large area of contact between the roller and pin to distribute the load thereon.

The bush is positioned within the area between the inner diameter of the roller and the pin. The bush provides a low friction contact surface between the supporting roller and the pin. In a preferred embodiment of the present invention, the cylindrical bush 130 is affixed to and rotatable with the roller about the stationary pin. Thus, the bush becomes the sliding surface on which the weight of the door resides. In one embodiment of the present invention, the bush is flanged 132 at one end to create an area of larger outside diameter than the body of the bush. In a preferred embodiment of the present invention, the bush is flanged 132 at both ends. The flanged ends of the bush cooperate with the areas of large diameter of the central aperture of the roller. This results in the middle area of reduced diameter being completely covered by the cylindrical bush and the adjoining areas at least partially covered by the bush flanges.

In one embodiment of the present invention, the support roller assembly is constructed to provide rolling support for large loads. To prevent excess friction, wear, or misalignment, the tolerances between the parts must be kept small. Therefore, in a preferred embodiment of the present invention, the outer diameter of the pin is dimensioned to be equal to or slightly less than the inner diameter of the bush. This snug fit prevents the support roller from moving radially with respect to the pin. Axial movement between the pin and the roller is prevented by the design of the pin.

In a preferred embodiment of the present invention, the pin is constructed of stainless steel or other similar metallic material and comprises a long shaft that extends through the bush and support roller. On an inboard end of the support roller the pin comprises an area of increased diameter 124 that abuts the flange 132 of the bush 130 in the event of axial movement of the roller. The flange at the inboard end of the bush provides a low friction surface for contact between the pin and the bush.

Means for securing the supporting roller to the pin are provided on the outboard end of the pin. In one embodiment of the present invention, the supporting roller is secured on the pin with a screw or bolt 128 and a washer 140. In this manner, the lateral play between the support roller and pin is adjusted by tightening or loosening the screw. In a preferred embodiment of the present invention, the support roller is secured to the pin with a riveted washer 126, 128. The riveted washer is secured to the end of the pin after the support roller is installed on the pin, thereby locking the lateral position of the roller with respect to the pin.

In a preferred embodiment of the present invention, with the support roller in position on the pin and the means for securing the roller in place, all contact between the pin 122 and the roller 120 occurs in the area of the flanged bush thereby providing low friction surfaces at all contact points between the two. The weight bearing roller primarily rotates about the pin in the area of reduced diameter 126. Lateral movement of the roller with respect to the pin is arrested on the inboard side by the engagement of the enlarged area of the pin with the inboard flange of the bush, and on the outboard side by the engagement of the washer or other securing means with the outboard flange of the bush. In this manner, there is no direct contact between the supporting roller and the pin.

In a preferred embodiment of the present invention, the bush is constructed of a rigid, low-friction, durable material, such as a metal-polymer bearing material. One example of acceptable metal-polymer bearing materials are the DU, DP-4, DP-20, and DH series of bearings manufactured by Glacier Garlock Bearings, Inc., Thorofare, NJ (USA). These metal-backed, PTFE-based polymer bearing materials have a common structure, consisting of a steel backing bonded to a porous bronze sinter layer. This bronze sinter layer is impregnated and overlaid with the filled PTFE bearing lining. These are particularly beneficial in that they are lead free and comply with the European Parliament's End of Life Vehicles directive (ref: 2000/53/EC) on the elimination of hazardous materials in the construction of passenger cars and light trucks. Other filled PTFE bearing materials are also highly suitable for use in the present invention. The bearing material is generally formed on a bronze backing for support. Such a material provides optimal anti-friction properties from the PTFE and corrosion resistance at a significantly lower cost than traditional ball bearings.

In one embodiment of the present invention, the roller assembly is adapted to be mounted to a moveable object. In a preferred embodiment of the present invention, the moveable object is a sliding automotive door. As illustrated in FIG. 2, the roller assembly 100, comprising a chariot 106 with a support roller 120 mounted thereto is hingedly attached to a door arm 102. The door arm connects the roller assembly to the automotive door. The hinge connection 104 comprising a pin extending through apertures in the chariot 106 and door arm 104 is spring loaded through a coiled spring which provides tension to retain the chariot 106 in a preferred position relative to the door arm, while allowing some movement between the two parts when the door is opened or closed. This configuration allows for minor self adjustments in the spacing between the door and the door frame. For example, when the door is in a closed position, it rests within the door frame such that the exterior of the door is flush with the automobile body. When the door is opened, it initially swings away from the automotive body before sliding down the guide track via the roller assembly.

In a preferred embodiment of the present invention, the chariot 106 functions as a platform on which other components are mounted. In addition to the support roller 120, at least one guide roller 108 is provided to assist in the horizontal alignment of the assembly. In a preferred embodiment of the present invention, two guide rollers 108

positioned on either side of the support roller 120 are provided. The guide rollers 108 are affixed to a horizontally extending portion of the chariot 106, which extends from a side of the chariot opposite the hinge connection 104. The horizontally extending portion provides a horizontal base on which the guide rollers are mounted. FIG. 4 illustrates the assembly 110 comprising the chariot 106 and the support roller 120 without any additional components highlighting the horizontal base.

In one embodiment of the present invention, the guide rollers comprise a horizontally mounted roller mounted on a vertically extending pin. The guide rollers do not carry any significant weight from the door but provide balance and positioning when the door experiences lateral forces.

The guide rollers 108 reside within a guide bar or tubular channel mounted in conjunction with the automobile body. The tubular channel is "C" shaped in cross section to provide a small opening through which the rollers and a portion of the horizontally extending portion of the chariot extend. The horizontally extending portion of the chariot enters into the tubular channel through the opening spanning the length of the channel while the guide roller extends vertically to engage the inner portion of the tubular channel. The channel is dimensioned such that it is wider than the diameter of the guide roller to allow the guide roller to contact only one side thereof. However, depending on the direction of force exerted by the door on the guide rollers, the guide rollers will either contact the near side of the channel or the far side of the channel.

Although the present invention has been described with reference to particular embodiments, it should be recognized that these embodiments are merely illustrative of the principles of the present invention. Those of ordinary skill in the art will appreciate that the apparatus and methods of the present invention may be constructed and implemented in other ways and embodiments. Accordingly, the description herein should not be read as limiting the present invention, as other embodiments also fall within the scope of the present invention.